REMARKS

Reconsideration of this application, as amended, is respectfully requested.

The amendments to claim 1 are intended to help clarify the nature of the invention.

The office action appears to view the language regarding uniform deposition as a result, rather than as a method of introducing the precursors as was specified in the claim. *See also*, Specification at [0033]-[0034]. By eliminating this language from the claim, any ambiguity is removed.

In addition, it is believed that the phrase, "exposing a wafer to a starved dose of a first chemically reactive precursor . . . selected to yield less than one-half of a maximum saturated ALD growth rate," better expresses the nature of the invention. This terminology is supported in the specification as originally filed, for example at [0067] where, in connection with the description of Fig 8B, it is indicated that, "the H2O is short . . . to achieve 0.55 A/cyc, a little less than half the maximum (ALD) saturation value." Use of the "less than one-half a maximum ALD saturation rate" language is also germaine to the enablement issue raised in the Office Action because this is a measurable parameter and remains less than anything reported by or obvious In view of Matero or Park (the previsously cited references).

Claim 11 has been rewritten as an independent claim (including the above-referenced amendments to claim 1) and is allowable for at least the reasons set forth in the Office Action. Claim 15 depends from claim 11 is therefore also allowable. New claims 51-58, which recite subject matter described in the specification as originally filed, also depend from claim 11 and are therefore allowable for at least the same reason as claim 11.

1. Claim 1 is Fully Enabled by the Specification as Filed.

The enablement requirement of 35 USC 112, first paragraph requires that the specification describe, sufficient for the purposes of one of ordinary skill in the art, how to make and how to use the invention that defined by the claims. The purpose of this requirement is to ensure that the invention is communicated to the interested public in a meaningful way. To comply with this obligation, however, it is not necessary to "enable one of ordinary skill in the art to make and use a perfected, commercially viable embodiment" of the claimed subject matter. *CFMT, Inc. v. Yieldup Int'l Corp.*, 349 F.3d 1333, 1338, 68 USPQ2d 1940, 1944 (Fed. Cir. 2003) (an invention directed to a general system to improve the cleaning process for semiconductor wafers was enabled by a disclosure showing improvements in the overall system). Indeed, it is

sometimes the case that merely reciting a limitation in a claim, which limitation is not even otherwise described in the specification, is sufficient for purposes of satisfying the enablement requirement. *See* MPEP 2161.

"[T]he PTO bears an initial burden of setting forth a reasonable explanation as to why it believes that the scope of protection provided by . . . [a] claim is not adequately enabled by the description of the invention provided in the specification . . . this includes . . . providing sufficient reasons for doubting any assertions in the specification as to the scope of enablement." *In re Wright*, 999 F.2d 1557, 1561-1562 (Fed. Cir. 1993). In interpreting these requirements, the BPAI has stated, "In other words, Section 112 does not require that a specification convince persons skilled in the art that the assertions therein are correct." *In re Armbruster*, 512 F.2d 676, 678 (CCPA 1975). Instead, "it is incumbent upon the Patent Office . . . to explain why it doubts the truth or accuracy of any statement in a supporting disclosure and to back up assertions of its own with acceptable evidence or reasoning which is inconsistent with the contested statement." *In re Marzocchi*, 439 F.2d 220, 224 (CCPA 1971). Thus, the threshold issue raised by a lack of enablement rejection is not whether the applicant has established that the specification is enabling. Rather, the issue is whether the Office has met its initial burden of providing a reasonable explanation as to why it is not. *Ex parte Liu et al.*, Appeal No. 2009-15302 (BPAI).

In this instance, the explanation proffered in the Office Action for insufficient enablement is that the claims require chemical reactions of selected ones of a "seemingly infinite number of gasses" and evaluating dosing, which is a highly exact science with little predictability, hence, undue experimentation would result. Office Action at p. 4. The undue experimentation is said to encompass determining which precursor material has a longer saturation time, the doses required to meet the claim limitations (specifically a dose for achieving starved saturation resulting in less than half of a maximum saturated ALD growth rate), and which gases will provide the claimed deposition rate (*i.e.*, a maximum starved ALD deposition rate). Office Action at p. 4.

The fact that experimentation may be complex does not necessarily make it undue, if the art typically engages in such experimentation. MPEP 2164.01. Furthermore, "The determination of what constitutes undue experimentation in a given case requires the application of a standard of reasonableness, having due regard for the nature of the invention and the state of the art . . .

The test is not merely quantitative, since a considerable amount of experimentation is permissible, if it is merely routine, or if the specification in question provides a reasonable amount of guidance with respect to the direction in which the experimentation should proceed to enable the determination of how to practice a desired embodiment of the invention claimed." *Ex parte Liu*, supra, citing *Ex parte Forman*, 230 USPQ 546, 547 (BPAI 1986). A specification need not necessarily describe how to make and use every possible variant of the claimed invention, for the artisan's knowledge of the prior art and routine experimentation can often fill gaps, interpolate between embodiments, and perhaps even extrapolate beyond the disclosed embodiments, depending upon the predictability of the art. *AK Steel Corp. v. Sollac*, 344 F.3d 1234, 1244 (Fed. Cir. 2003), and see, *Amgen, Inc. v. Hoechst Marion Roussel*, Inc., 314 F.3d 1313, 1334 (Fed. Cir. 2003).

In the present case, the reasoning employed in the Office Action is for lack of enablement is rebutted by the evidence provided via the Declaration of Professor Steven George, submitted herewith. For example, contrary to the assertion in the Office Action, Dr. george indicates those of ordinary skill in the art would not look to an "infinite number" of gases from which to select precursors for an ALD reaction, because it is already well-known in the art that there are but a finite number of gasses suitable for such purposes. See Declaration of Steven M. George at para. 7. It is also known that of these ALD-suitable gasses, there are fewer still that, when paired in an ALD reaction, have dissimilar reaction times. *Id.* Indeed, the present Specification provides detailed guidance to one of ordinary skill in the art with respect to how gasses should be selected: In addition to combinations of TMA/H2O, it is specifically noted that combinations of TiCl4/NH3 and various metal chlorides with H2O or NH3, Specification at [0035]-[0036], non-metal bearing precursors containing an oxidant or a nitridant, with a metal-bearing precursor, Specification at [0075], and HfO2, ZrO2 and other oxides (La2O3, TiO2, Y2O3, and SiO2) with various nitrides (Si3N4, SiN, WN, TiN and TaN), Specification at [0080], may be employed. Indeed, it is precisely because the Specification mandates the use of gasses with non-similar reaction rates that any experimentation that might otherwise be required is actually not undue and is limited to selection of gasses from a defined range of ALD precursors. *Id.*

In addition to the kinds of precursors, the Specification also prescribes the order in which they would be used. For example, for the TiCl4/NH3 chemistry, the present Specification indicates that because that the precursor having the slower reacting half reaction is used as the

first reactant. This recipe-like discussion of both the nature and the order of application of the precursors eliminates (rather than leads to) any undue experimentation.

Likewise, the uniformity requirements are discussed in the Specification in detail. See e.g., Specification at [0043] - [0045], and [0051] - [0053]. Examples are provided to ensure that "the precursors are delivered in a spatially distributed fashion substantially simultaneously to all points of interest on a substrate for a specified time interval." See, e.g., Specification at [0051] (describing use of a diffuser or distribution plate to ensure introduction of the precursors in a manner so as to provide a substantially uniform film deposition on the wafer.) "It is known that when ALD doses which are less those used to provide saturation (e.g., for the slower reacting reactant), then uniformity can be achieved by using a uniform injection of precursors into a reaction chamber, as is practiced in CVD, and described in the present Specification." Declaration of Steven M. George at para. 8. Here again, by being specific about the nature of the equipment used to effect the claimed process, the Specification eliminates the need for experimentation.

Finally, as discussed By Dr. George, once a pair of reaction chemistries is characterized for an ALD process showing saturation in both half reactions, there is high predictability and repeatability for the chemistry. The underlying mechanism for this is known from surface chemistry reactions. In the context of the presently claimed invention, the starved non-metal reactions take place at the surface, forming an assembly of non-saturated active -OH (hydroxyls) terminations to provide a fractional area coverage (set by t_s in contrast to conventional ALD, i.e., using t_b or t_{ex} of Fig 1A and 1B). The sequential metal precursor (e.g., TiCl4) reactions chemically bond to those limited –OH active surface sites, resulting in the starved saturated level under metal precursor exposure; the metal precursor reactions leaves reactive terminating ligands (e.g., -CH3 in the case of TMA, and NH3 in the case of TiCl4) terminations for the next starved half cycle. This chemistry is highly predictable. Given the guidance of applicant's disclosure, one of ordinary skill in the art would not need to resort to undue experimentation to employ the claimed process with precursors other than TMA/H2O. See Declaration of Steven M. George at para. 9.

The key to any assessment of enablement is not whether experimentation is required, it is whether any experimentation would be undue. *In re Angstadt*, 537 F.2d 498, 504 (CCPA 1976). This requires an assessment of:

(A) The breadth of the claims;

(B) The nature of the invention;

(C) The state of the prior art;

(D) The level of one of ordinary skill;

(E) The level of predictability in the art;

(F) The amount of direction provided by the inventor;

(G) The existence of working examples; and

(H) The quantity of experimentation needed to make or use the invention based on the content of the disclosure.

In re Wands, 858 F.2d 731, 737, 8 USPQ2d 1400, 1404 (Fed. Cir. 1988).

Here, the claims are narrowly crafted to define a certain class of precursors that exhibit defined characteristics with respect to one another and which are applied in a specified order in an ALD process. The nature of ALD processes is known and the inventors have provided clear articulation of the precursors to be employed (e.g., by means of specifying their relative saturation rates) and a detailed example of a popular chemistry in order to demonstrate the nature of the claimed process. Coupled with the existing level of ordinary skill in the art, Dr. George's declatation has established that no undue experimentation would be needed to apply these teachings with other chemistries. Hence, the Specification is fully enabled for the present claims.

If there are any additional fees associated with this communication, please charge Deposit Account No.: 19-3140.

Respectfully submitted,

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